AL.1.1060 C.2

VOLUME 2, NUMBER 2 AUGUST 1990

Alberta
TRANSPORTATION
AND UTILITIES

TRANSPORTATION RESEARCH TRANSEARCH

A RESEARCH AND DEVELOPMENT TECHNICAL PUBLICATION

The MAP and IMAGE PROCESSING SYSTEM

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EDITOR'S NOTE - *Ray Filipiak*

C-SHRP/SHRP Technology Transfer Kickin' In

SHRP will be mailing 10 copies of all published final reports to the State/Province Program coordinators. The Coordinators will be asked to determine how the reports should be distributed within their respective jurisdictions. The distribution is likely to vary depending upon the subject matter of the report. In many cases, SHRP will send a cover letter including suggestions for distribution (for example it may be suggested that a particular report be forwarded to the materials section of the D.O.T.).

As reports are published their availability will be anounced in TRANSEARCH. Beginning in late 1990 or early 1991, the Alberta Transportation and Utilities Library will retain 3 copies of each final report. These reports will be catalogued and will be available for loan. The Research and Development Branch will retain one reference copy of each report, some will be distributed to specific targets and the remainder will be available to anyone who requests one on a first come first served basis.

All of SHRP's published reports, including final reports, as well as working papers and interim reports that are of broad interest will be available for purchase through TRB. TRANSEARCH will provide more information on this as it becomes available. Refer to SHRP PUBLICATIONS on page 12 for list of available reports.

About This Publication

The **TRANSEARCH** quarterly publication is prepared by the Research and Development Branch of Alberta Transportation and Utilities. The publication is dedicated to the effective transfer of transportation and utilities related research information and state-of-the-art technologies throughout the department.

In short news and feature articles, **TRANSEARCH** reports on the most interesting research and technologically significant events concerning the department.

In the interest of providing a vehicle for the effective transfer of technology throughout the department, Research and Development encourages department staff to provide proposals containing unique ideas, innovations or opportunities for research and evaluation which may provide solutions to the various technical needs of the department.

This publication is distributed throughout the department of Alberta Transportation and Utilities. Back issues will be catalogued and retained in the department library. Copies of **TRANSEARCH** are also distributed to other Canadian D.O.T.s as well as Alberta Cities.

Comments and suggestions may be submitted to:

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AIRPHOTOS ONLINE - The Map and Image Processing System

CANADIANA
AUG 20 1990

by Vern Kennedy

Imagine being able to take all the information in 25 Edmonton white page telephone books and storing them in a space roughly the size of a softcover novel. Using optical disk computer storage technology, the Air Photo Services section of Roadway Planning Branch is doing that and more with their recently acquired Map and Image Processing System (MIPS). Purchased from a local Alberta distributor, the MIPS system was developed by Micro-Images, Inc. of Lincoln, Nebraska, originally for use in forest inventory and land use classification applications. Now used in 28 US states, the system has grown to be used in many different applications requiring manipulation and storage of large numbers of images, including GIS database systems, electronic atlases, analysis of wetlands and infrared spectral image analysis.

DOING IT THE OLD WAY - Sam Zasadny of Airphoto Services lays out a mosaic by hand - In future this method will be superseded by using the MIPS system.

The system was purchased as a research initiative by Research and Development Branch in December of 1989. The configuration consists of a 80386 based microcomputer equipped with high resolution monitors, mouse, a 150 Mb hard disk drive, a scanner to input photo images into the system, an optical disk storage device capable of storing 600 Mb of data (equivalent to 600,000,000 characters) on a single disk, as well as a printer for output of 8 1/2 x 11" image prints. The branch will initially use the system to index and manage the more than 1 million item air photo image library maintained by the branch. According to Ed Hammond, section head, "It will not only provide us with a method of computer digital data base storage for our aerial photography and indices but will also afford us the capability of importing and processing digitized image data from the SPOT IMAGE, Landsat and Radarsat satellites".

The premise behind using the system is that all images of interest are scanned, then enhanced, changed or combined using the extensive drawing, painting, measurement and image manipulation tools provided with the software. The Airphoto Services system is capable of producing scanned images of resolution from 75 to 300 dots per inch in black and white or color and storing them on electronic disk storage. Once scanned, the image can be displayed on the screen and further analyzed. This analysis can include measurement of lines and areas on the image, color adjustment, splicing of images (mosaicing) and drawing over images. Any operations performed can be saved as a new image or, if desired, the original image can be permanently altered. A combined text and graphic interface assists the user in navigating the system.

One of the most useful features of MIPS is its ability to incorporate all the image information into a database which can be accessed via a graphical interface. For instance, at the highest level, the initial display might show an image of the province of Alberta. Clicking a mouse pointer on a particular area will bring up another image associated with that area, or if multiple images are registered in that area, the user is prompted to select exactly which image he wishes to see. The graphic database can have multi-

ple levels, so that the user can find an image by going from an image of the entire province, to an image of the south half of the province, to an image of a particular quadrant of the south half of the province, and so on right down to a particular aerial photograph. Because of the way the data is structured, the user does not need to start at the highest level in the database hierarchy, rather, he can start from an image further down, for instance in one quadrant of the south half of the province and go from there.

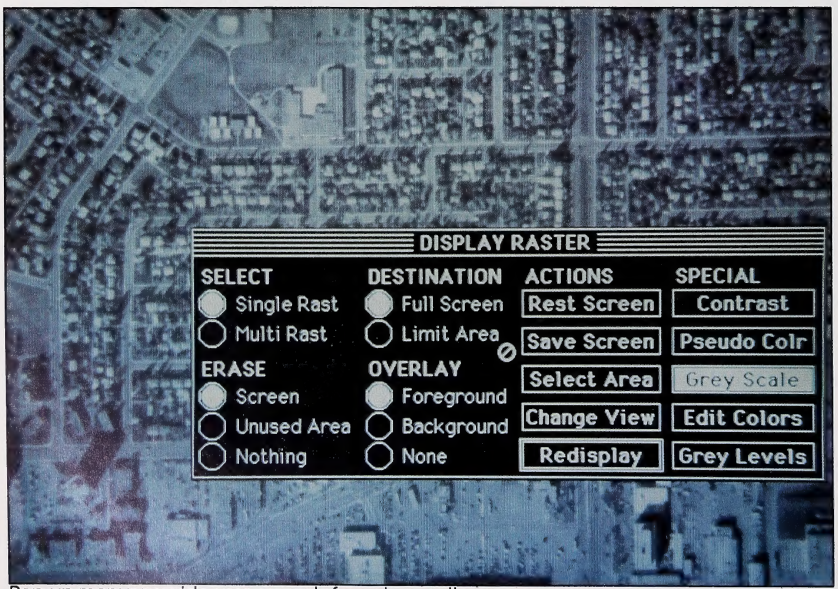
Another interesting feature of MIPS is its ability to combine elevation data with image rasters (arrays) to produce three dimensional views of air photos. Using this feature, an oblique view of an area can be created. The system also allows the view orientation to be changed so that an area can be viewed from any angle.

MIPS Workstation - state of the art in low cost GIS system

Until recently, airphoto mosaics have been built by hand in a cut and paste operation. The built up mosaic is then sent out for re-photographing, with subsequent generation of a diapositive which can then be used to make multiple paper prints of the mosaic. The whole process can take several days even for small mosaic construction and is very costly. The MIPS system automates this process. After several photos are scanned into the system and registered to map coordinates, they can be joined together and saved as a larger common image. Using the MIPS system reduces the time required for mosaic building from several days to several hours. The image can then be printed out in as many copies as necessary. Although the Air Photo Services section does not presently have output capability for large image formats, the Department has a large format electrostatic plotter located in Information Systems Branch. Special device drivers can be purchased that will allow the large MIPS images to be output directly to that plotter. Information Systems is currently investigating the purchase of one of these drivers.

Another area where the MIPS system will prove useful is in the production of orthophotos, or air photos that have been altered to correct distortion due to parallax and changes in ground - camera distance during photographing. The system lets the user correlate features on the image to known map coordinates, then stretches and shrinks portions of the image to produce an image with corrected ground distances. Orthophotos are currently produced by using a mechanically driven projector to produce a new negative. The distance from the projector to the negative is continuously changed based on input from a digital model and the end product is a new corrected negative. Using the computerized technique as found in MIPS will substantially decrease the time required for production of these orthophotos.

In addition to these advanced



Pop-up menus provide user prompts for system actions.

continued on Page 6

Anti-Corrosive Deicing Chemicals..... Deicers of the Future?

by Alan Mah

In Alberta, winter never seems to be too far away. For Alberta Transportation and Utilities, preparing for winter means constructing sand/salt stockpiles, calibrating sanding trucks and hoping that the upcoming winter will be a mild one. While no one can predict how severe each winter will be, we do know that large amounts of deicing salt will be used to provide safe roads. Last winter Alberta Transportation and Utilities used approximately 100,000 tonnes of deicing salt!

While the generic term "salt" can apply to a number of chemicals having different composition/characteristics, in highway winter maintenance, salt almost always means sodium chloride. Because of sodium chloride's good performance and affordability, it has long been used for deicing. However, it also has delitirious effects such as corrosion, in reinforcing bars in concrete, steel structures, automobiles and accelerated scaling of concrete under freeze-thaw conditions.

As we enter into the '90s, many jurisdictions are looking at ways to minimize the negative effects associated with salt use, and our Department is no exception. We are presently looking at various ways of addressing this problem. One aspect involves looking at improved salt management. The other aspect involves the search for less harmful deicing chemicals.

A number of "anti-corrosive" deicers which were recently introduced in the market claim to reduce or inhibit corrosion. In late 1989, the Materials and Operations Section of the Research and Development Branch initiated a project aimed at evaluating four such "anti-corrosive" deicers as possible salt alternatives. Most of these deicers had only undergone limited testing.

The objective of the testing program set up by the Department was to evaluate the deicing properties, concrete compatibility and corrosion inhibiting properties of four deicers, namely Freezgard+PCI, Qwiksalt+PCI, TCI and CG-90. Freezgard+PCI is supplied in a liquid form, whereas the other three deicers are supplied in a coarse granular form. Sodium and/or magnesium chloride are the major components of all four salt alternatives. An unknown special additive is said to provide each deicer with corrosion inhibiting properties. The attached photograph illustrates the physical appearance of each deicer, from conventional salt on the far left to TCI on the far right.

NaCl | FREEZGARD + PCI | QWIKSALT + PCI | CG-90 | TCI

The testing program started in January, 1990 and is scheduled for completion in March, 1991. The following is a brief description and status of each test undertaken in the program.

Ice Melting Ability Test:

Interim results show that the fine grain sodium chloride has a higher rate of ice melting ability than the other deicers with coarser grain size. Differences in gradation between the deicers will be considered when analyzing the final results.

Concrete Compatibility Test (ASTM C672):

This test is now completed. After 50 freeze-thaw cycles, sodium chloride caused the most scaling effects on concrete surfaces, and was followed by TCI, and Qwiksalt+PCI. Freezgard+PCI and CG-90 had only minimal scaling effects. These scaling effects are shown on the attached photograph.

"Time-to-Corrosion" Test:

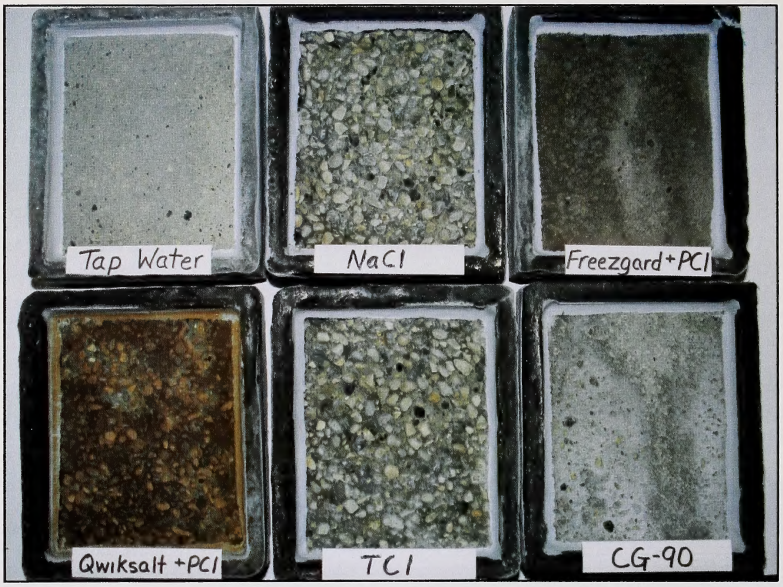
This test was undertaken to determine the deicers' ability to inhibit corrosion by monitoring the onset and rate of corrosion over time. After 12

weeks, the sodium chloride specimen produced the largest detectable amount of corrosion current, followed closely by the TCI, CG-90, and Qwiksalt+PCI specimens. The Freezgard+PCI specimen had barely any detectable corrosion current. Testing will continue for 48 weeks.

The test results to date indicate that all four anti-corrosive deicers tested in this evaluation are less corrosive to steel and more compatible with concrete than conventional sodium chloride. The ice melting ability of the anti-corrosive deicers require further study.

These salt alternatives are costly. Freezgard+PCI and Qwiksalt+PCI cost approximately $250 per tonne. TCI and CG-90 are currently not available locally and will be slightly higher than $250 per tonne. This compares to $50 per tonne (F.O.B. Edmonton) for sodium chloride.

A review of the final laboratory test results coupled with a cost-benefit analysis will assist us to determine which of the anti-corrosive deicers tested, if any, would be suitable for Departmental use. An interim report is available that describes the anti-corrosive deicers, the testing procedures used and the results to date.



Although sodium chloride has proven its worth to the Department in the past, less corrosive salt alternatives will continue to be the focus of attention in the years to come. So watch out sodium chloride, soon there could be a new kid on the block -ice block that is!

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AIR PHOTOS ONLINE continued

uses of MIPS, the system can be also used for such day to day activities as labelling features on aerial photographs. This is done by scanning the image, then using the system to place text over the photo. The resulting image with text can then be output for inclusion in a report or as a back-up graphic for correspondence.

In future, the image data to be maintained with the MIPS system is seen as usable by all areas of the department, via network links to a central image database. This will allow the entire department to reap the benefits of the MIPS system installation. Says Hammond, "The system provides a world of electronic mosaicing, articulating both image and vector data interactively. We have now had sufficient experience with the system to say we are delighted".

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How to Get Those Creative Juices Flowing

Ever get stuck on a problem? Just can't figure out a solution. I do all the time. Working in a R & D environment that continuously demands looking at problems from a different perspective and finding or developing solutions that are usually unconventional or unfamiliar to accepted standards puts me in this position frequently. Sometimes just sleeping on it works. Sometimes I need more than that to get those creative juices flowing.

A few years ago I came upon some literature that contained, among other things, a checklist of questions designed to spur ideation. These questions are generic in nature and can apply to any type of work environment. Try them sometime - I dare you! You'll be surprised.

PUT TO OTHER USES? New ways to use as is? Other uses if modified?

ADAPT? What else is like this? What other idea does this suggest? Does the past offer a parallel? What could I copy? Whom could I emulate?

MODIFY? New twist? Change meaning, color, motion, sound, odor, form, shape? Other changes?

MAGNIFY? What to add? More time? Greater frequency? Stronger? Higher? Longer? Thicker? Extra value? Plus ingredient? Duplicate? Multiply? Exaggerate?

MINIFY? What to subtract? Smaller? Condensed? Miniature? Lower? Shorter? Lighter? Omit? Streamline? Split up? Understate?

SUBSTITUTE? Who else instead? What else instead? Other ingredient? Other material? Other process? Other power? Other place? Other approach? Other tone of voice?

REARRANGE? Interchange components? Other pattern? Other layout? Other sequence? Transpose cause and effect? Change pace? Change schedule?

REVERSE? Transpose positive and negative? How about opposites? Turn it backward? Turn it upside down? Reverse roles? Change orientation?

COMBINE? How about a blend, an alloy, an assortment, an ensemble? Combine units? Combine purposes? Combine appeals? Combine ideas?

ELVIS ALIVE!

Elvis seen on cracksealing crew in District 6

SCIENTIFIC REPORT STATES HIGHWAY CRACKING DUE TO CONTINENTAL DRIFT

THE HIGHWAY INQUIRER

Cone heads survey highway 63, for possible landing strip, for future invasion

Senior A.T. & U. official states reasonable explanation available for potholes...

Oil in asphalt concrete used to power alien space ships!

WHAT INQUIRING DRIVERS WANT TO KNOW

"To Transfer Technology Or Not To Technolgy Transfer ..."

Some Philosophical Rheteric On Technology Transfer

by Ray Filipiak

One of Darwin's theories suggests that evolution is based on natural selection, or in more familiar words - survival of the fittest.

Could this theory apply to technological evolution? This question came to mind during the 1990 Western Association of Canadian Highway Officials (WACHO) Confererence which was hosted by Alberta Transporatation and Utilities in Edmonton this last April. After having some interesting discussions with peers who attended the Technology Transfer Technical Group Session, I began to wonder. A colleague and a good friend put it this way "... its not technology transfer that needs to be sold to the user but the products of research and development that need to be delivered to the end user in a usable form ... for all the user cares about is the product and whether it helps him do his job more efficiently and less expensively ... he could not care less about the processes used to deliver the products... the trick is determining what are the bounds of this process of technology transfer, what constitutes the responsibilities of a technology transfer agent".

In this day and age of information overload deciphering technical research documents and translating them into a useable form constitutes a monumental task. The fact is that there are not enough resources to perform this task effectivley. So the question becomes - "Where do we draw the line with technology transfer?" Do we attempt to address every need in technological improvement identified by the user and then set off on an expedition to find the solution.

On the other hand, do we try to digest every iota of research documentation available, translate and repackage it and target it at a potential user? Or, should we do what nature does and let the process of natural selection take over? In other words - the strongest needs will have the strongest lobbying and will eventually be addressed while the lesser needs will fall by the way side. Conversely, the technological innovation with the greatest potential will be the first to be evaluated and implemented and those of lesser merit will also fall by the way side."

I must also add that technological innovation is not a one way street. That is, researchers are not necessarily the only innovators. Many valuable innovations are developed by users.The problem that occurs here is that many of these types of innovations are developed/created and then used in isolation.

Therefore, is it also the reponsibility of the technology transfer agent to facilitate the exposure of these types of innovations? Here again though, where does the agent draw the line? Does he go in search for these isolated innovations or does he wait for them to be brought to his attention? Chances are that the former will be the case - since by their very nature these isolated innovations are very shy and timid.

These particular questions among many other difficult questions and issues were raised at WACHO. The other interesting issue was that of a definition or terms of reference for technology transfer. Although, a global definition would be nice we quickly resolved that it can't be so. The reason is that even within the highway industry there are demands for customized definitions for this process. What a national agency such as RTAC requires in technology transfer differs from what a D.O.T. such as A.T.& U. requires which differs from what a local road authority such as a municipality or county requires.

I have been working on the subject of technology transfer for over a year now and I am beginning to resolve to a philosophy that as a technology transfer agent I am nothing more than a catalyst or a communications link between users and the researchers. I can do no more than facilitate the communication between the two and between themselves. I really can not take the role of a judge and determine which technology is good or which is bad, although I can recommend which ones have the greatest potentials. As for the process of selection, the Darwinian way may be the way to go.

The author would be very interested to hear the comments of the readers.

Please contact the TRANSEARCH Editor (address and telephone located on page 2 of this publication).

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STAFF NOTE:

The Roadway Engineering and Equipment Section of R&D lost one of its project engineers, Vern Kennedy, to Information Services Branch in early July. Vern has been with the section for three years and has done some outstanding work, including the MIPS demonstration he describes in this issue's feature article.

Our loss is certainly ISB's gain.

Good luck and best wishes in your new position, Vern!

Paint by Number

by Zach Zacharia

Some bridges in Alberta are beyond the recoatable paint stage! So says The Bridge Paint Expert System (BPES) developed by Bridge Materials Section and Research and Development Branch.

It has been common practice throughout North America to repaint a bridge only after the paint shows signs of rust and some corrosion has taken place. Since the old paint has failed most of it has to be removed and then all four coats are replaced over the entire structure. This entire process has to be repeated approximately every 25 years at a cost of $80,000 for the "average" bridge.

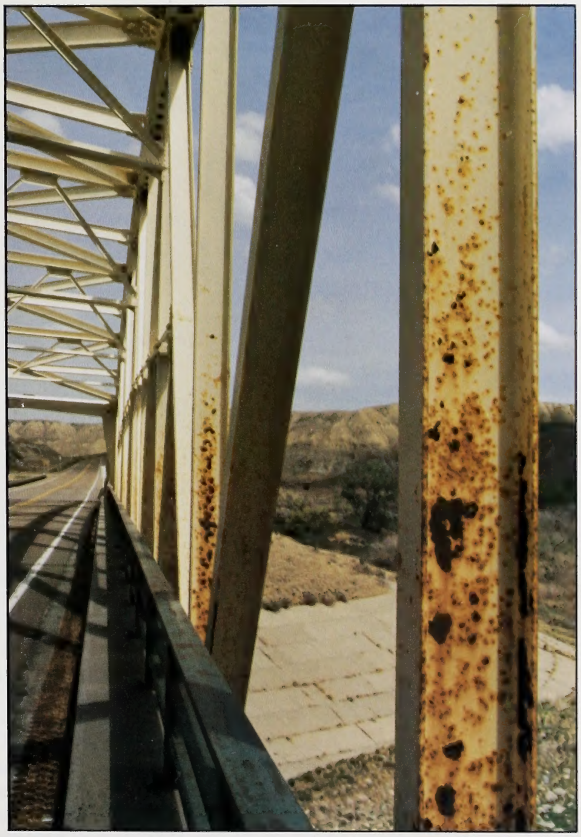
If the lead based paint which is removed has to be disposed of at a hazardous waste site the costs could increase to $160,000 per "average" bridge. Lead based primers provide better rust inhibiting characteristics than most other primers which greatly increase the available paint life. Therefore it is more valuable to leave the paint and primer on the bridge as long as possible. The most cost effective method of painting a bridge is to add a new coat of paint just before the original paint has given up its useful life and will still retain an additional coat of paint.

The problem is to identify the exact time to recoat the paint. By the time the paint has visual signs of distress it is too late. If an overcoat is applied at that time there will be an extremely high risk that the paint will not last.

BPES identifies the best time to recoat by analyzing the following eight pieces of data:

1) Percentage of rust showing
2) Adhesion of the existing paint
3) Thickness of the paint film
4) Year last painted
5) Substrate surface preparation
6) Peeling of existing paint
7) Paint film condition
8) Visual surface condition (Chalking, Fading, Dirty)

These tests are standard ASTM tests which are simple to learn and use.



BPES evaluates and combines the results of the eight tests applied to the existing paint and assigns the paint to a particular category of risk to recoat. The ten categories of risk that BPES uses are:

1) No Risk
2) Very Low Risk
3) Low Risk
4) Low Medium Risk
5) Medium Risk
6) Medium High Risk
7) High Risk
8) Very High Risk
9) Extremely High Risk
10) No Recoat

According to BPES a substantial portion of the bridges in the Bridge Branch database are beyond the Medium High Risk category. The paint condition on these bridges has deteriorated to such a point that it is better for the paint to completely fail, remove any existing paint and then put on four new coats. BPES has already classified all the components of the bridges in the database to specific categories of risk.

BPES provides a method to analyze and compare different bridges in the system. Examining the results using all the bridges in the database has indicated 17 years as being the most optimum time to repaint. Instead of removing the paint and putting 4 coats every 25 years a single coat every 17 years would do. To paint an "average" bridge would then cost $13,000 instead of $80,000 which would translate to a saving of over $800,000 per year.

Using the results from BPES, the order in which bridges should be painted can be determined. There are actually two points in the life of the paint where the structure should have a high priority for repainting. As the BPES rating rises on the one to ten scale, the priority increases to a maximum at level six (Medium to High risk to recoat). This is the most economical point to repaint the bridge and is given the highest

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C-SHRP/SHRP In Action

by Robert Powers

This May the C-SHRP and SHRP LTPP (Long Term Pavement Performance) programs came to life as the initial round of tests were completed on each of Alberta's test sections. The objectives of these tests were to determine the materials used and how the road was constructed, and to establish the present condition of the roadway. The testing and sampling of the C-SHRP/SHRP sites went smoothly with virtually no setbacks. The project was completed in only eight days. Right on schedule!

The testing and sampling procedures were almost identical for each site except for the number of samples that had to be taken. The frequency at which samples were taken was determined by the type or class of the site. At the present time Alberta Transportation and Utilities has a total of seven test sites that are strategically located throughout the province. These seven test sites are made up of one C-SHRP LTPP site, five SHRP GPS (General Pavement Study) sites, and one SHRP SPS-5 (Specific Pavement Study - Rehabilitation of Asphaltic Concrete Pavements) site.

To maximize the efficiency of the testing and sampling operation, the duties were delegated to four individual crews who were each responsible for one aspect of the operation. The samples taken at each site included asphalt cores varying in size from 100 - 300 mm in diameter, and a 300 x 300 mm asphalt block which was cut from the 1.2 x 1.8 m test pit slab. Bulk and moisture samples were taken from each layer during the drilling process, as well as from the test pit. The test pit provided an excellent opportunity to retrieve large bulk samples from each layer and provided a visual of how the road was built from the subgrade on up to the surface of the asphalt.

The on site tests that were conducted included two passes with the FWD (Falling Weight Deflectometer), one pass in the outer wheel path and another in between wheel paths. The FWD determines how the road reacts when a load is applied. The FWD simulates the load of a number of different classes of vehicles (heavy trucks to passenger vehicles) that frequently use the road. Density and moisture reading were taken with a nuclear gauge in the test pit from the undisturbed layers of the base, subbase and into the subgrade. On the C-SHRP LTPP test site the test pit excavation included taking CBR (California Bearing Ratio) readings on the base, subbase and subgrade materials. The CBR test is used to determine the bearing strength of the material in each layer.

In the coming months each of the C-SHRP and SHRP sites will have a traffic monitoring device installed. These devices will record the volume of traffic the road is carrying per day. The results will be used to correlate the average daily traffic and traffic loads to the rate the road is deteriorating.

The C-SHRP LTPP site and the SHRP SPS-5 site west of Edson on Hwy. 16 have both been scheduled to be overlayed this summer using several different overlay strategies. The C-SHRP site which consists of four 150 m test sections will be overlayed using a different rehabilitation strategy on each of the sections. The techniques that are to be studied will include virgin or recycled asphalt placed in two lifts. The first lift will be 50mm, followed by a second lift of 50mm or 120mm for a total of 100 mm or 170 mm respectively will be added.

The overlay strategy that is going to be used on the SHRP SPS-5 site will involve seven different rehabilitation techniques. The SPS-5 site consists of eight sections, the first of which will serve as a control. The rehabilitation strategies will involve a combination of

a 50 mm or 125 mm mat of virgin or recycled asphalt placed on a milled surface (intensive surface preparation) or on the existing asphalt surface (minimal surface preparation).

These sections of road will then be monitored and tested over the next ten to fifteen years in order to determine which rehabilitation strategies proved to be the most effective. All the research data that is retrieved from the Alberta test sites and from the approximately 1000 other sites located throughout the continent will be analyzed and entered into a national data base. This data will be used to formulate new road design criteria. Pavement Design Engineers from all over North America will then be able to access the data base and retrieve information on a rehabilitation strategy or pavement design that has proven itself to be the most effective in conditions similar to their own.

On a personal note, I would like to take this opportunity to thank all the Districts who participated in these programs by providing the traffic control and the patching crews.

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PAINT BY NUMBER continued

priority.

If the BPES rating exceeds six, it is too late to just topcoat the existing paint. The paint should then be allowed to deteriorate further before removing it and replacing it with a new four-coat system. Therefore level seven (High Risk) becomes a low priority. The priority again rises with higher ratings until it peaks at No Recoat where the paint is in such poor condition that corrosion could affect the strength of the bridge.

Another advantage of BPES is that it only analyses one component at a time. Since areas of the bridge deteriorate at different rates it is possible to repaint each component when required to obtain the maximum life possible from the paint. This would reduce the chance of painting some areas of the bridge too early.

BPES will be distributed to each of the regions with a user manual and testing information. Since BPES can be stored in a 720k diskette it is possible to run BPES on an IBM/compatible laptop computer. This would enable personnel to evaluate a bridge, member by member, in the field if necessary. As users gain familiarity with the type of reasoning employed by BPES they would start to realize which tests were important and how to weigh each test. This factor of training is another advantage of expert system development where the expertise is duplicated throughout the department and is transferred to less experienced personnel.

BPES is based on the expertise of Bob Lasby P. Eng. a paint corrosion expert and Wil Hamilton P. Eng. director of Bridge Materials Section. BPES was developed by the author using an expert system program called 1st Class Fusion.

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Emerging Technologies in Navigation

A seminar on Emerging Technologies Related To Transportation Navigation was held in Edmonton, May 31st, 1990. This seminar was organized by Dr. Bill Johnson of Transport Canada and John Lowe of Alberta Transportation and Utilities. Dr. Krakiwsky, Dr. Schwarz and Dr. Lachapelle from the University of Calgary discussed future trends in Global Positioning Systems, Loran-C, and Inertial Navigation Systems. (See last page under interesting publications)

Bill Johnson discussed Intelligent Vehicle Systems and The Heavy Vehicle Electronic License Plate Program. Al Werner of Systems Planning made a presentation on the Department's Computerized Highway Network. The seminar was attended by Department personnel as well as from other Government departments, Transport Canada and the private sector.

Contact Research and Development Branch for further information.

INTERESTING PUBLICATIONS

REPORT NO.: N/A

Title: GPS - A Guide To The Next Utility

Author: Jeff Hurn - Trimble Navigation

Brief: A very "user friendly" publication explaining the state of the art and application of Global Positioning System satellite technology.

REPORT NO.: N/A

Title: Assessment Of Emerging Technologies For Future Navigation Systems In The Canadian Transportation Sector (April 1990)

Author: E.J. Krakiwsky; G. Lachapelle; K.P. Schwarz

Brief: This report was prepared by the University of Calgary for the Research and Development Policy and Coordination - Transport Canada and addressess trends in navigation technologies such as inertial navigation systems, GPS, LORAN-C.

REPORT NO.: ABTR/RD/RR-90/03

Title: Installation Of Plastic Pipe Liners Within Existing Corrugated Steel Pipe Culverts

Author: Brian A. Hunter

Brief: The concept of using plastic pipe as a liner inside an existing CSP culvert is investigated to see whether a cost effective way of extending the service life of the culvert could be developed and considered as a rehabilitation alternative.

SHRP PUBLICATIONS

REPORT NO.: N/A

Title: Concrete And Structures: Progress and Products Update November 1989

Author: SHRP

REPORT NO.: SHRP-A/IR-89-002

Title: Materials Reference Library: Asphalt Selection Process August 1989, Revised October 31, 1989

Author: Center for Transportation Research. The University of Texas at Austin

SHRP Contract: A001

REPORT NO.: SHRP-C/WP-90-001

Title: High Performance Concretes. An Annotated Bibliography, 1974-1989 March 15, 1990

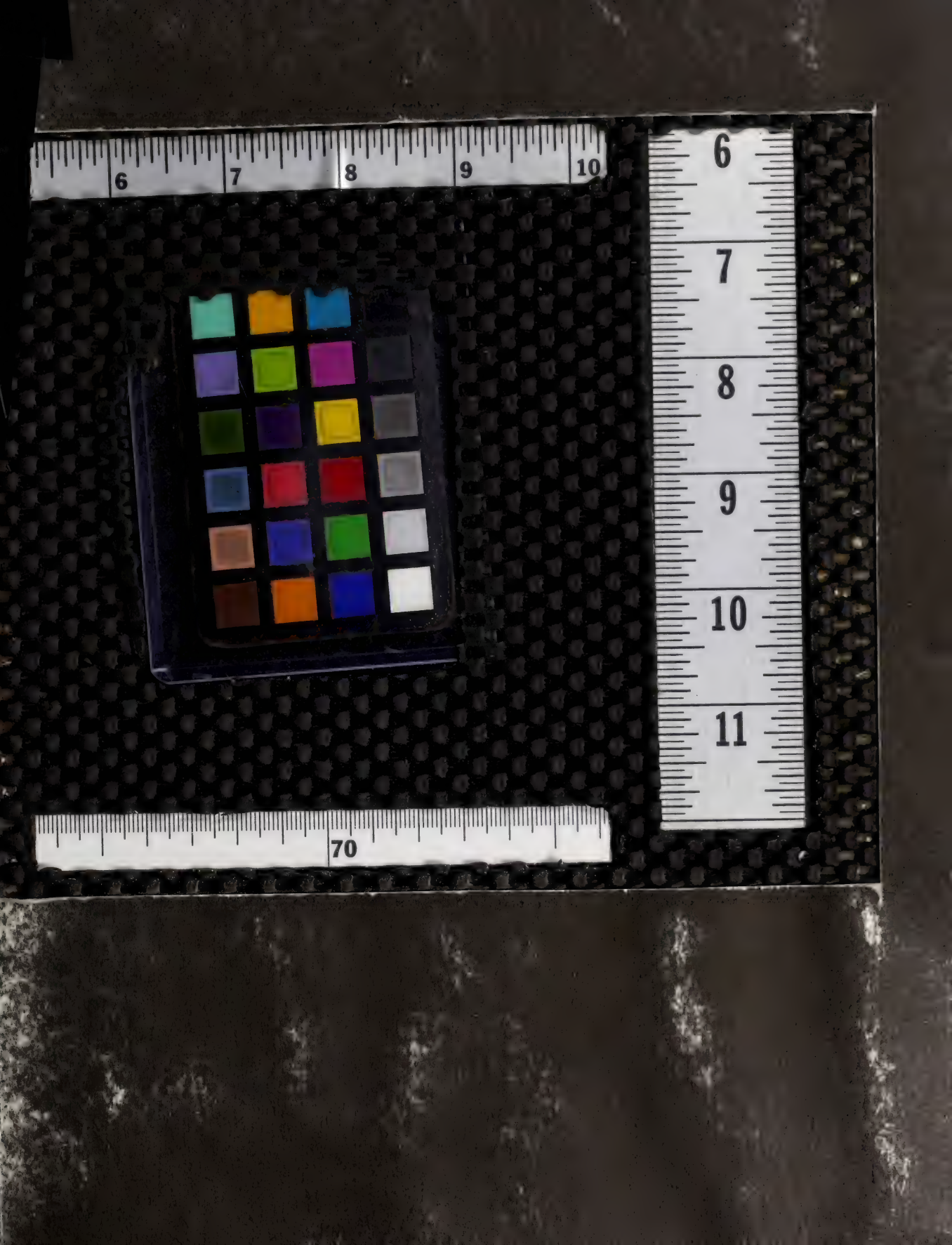
Author: SHRP

SHRP Contract: C205RCH.

Beginning in late 1990 or early 1991, theAlberta Transportation and Utilities Library will retain 3 copies of each final report published by SHRP. These reports will be catalogued and will be available for loan. The Research and Development Branch will retain one reference copy of each report and some will be distributed to specific targets within the Department.

VIDEO LIBRARY

The FHWA (Federal Highway Administration) has an extensive library of video tapes, slide shows and films on a variety of topics and are available to Alberta Transportation and Utilities free of charge. All that is required to order a selection is to call the Federal Highway Research Report Information system in McClain, Virginia at(703) 285-2144. You will require the film title and number and the Research and Development Branch Identification number. The selection you have made will then be shipped to the Twin Atria Building at no cost and we will then forward it to you for a period of 14 days at which time you return it to the FHWA. To obtain the Research and Development Branch Identification number and an updated list of the available video tapes, slide shows and films contact Robert Powers at 422-2750.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R & D Publications

COVER PAGE

Matrix of photographs taken during C-SHRP and SHRP activities in 1990.

EDITOR'S NOTE

C-SHRP and SHRP began this year with a bang. Back in May of this year we sampled and ran preliminary tests on test sites located on various highways through out the province. In late August we began actual construction of some pavement test sites. The Districts, Materials Branch and Lab, and operations people fought through rain, snow and sleet. We fought through bitter cold winds. And we fought through unforeseen acts of God such as lightening strikes.

On other battle grounds the Bridge guys have been actively working on the concrete and structural technical research areas of these programs. All in the effort of supporting the C-SHRP and SHRP programs. All in the effort of developing better designs, methodologies and procedures used in the everyday operations of this department.

But, the task is not over. We have just begun! There is no way in the world that such enormous undertakings such as these two programs could be successful without the assistance and cooperation of many people within this department. Unfortunately there are too many of you to list and not enough room to do it. Suffice it say that the Research and Development staff is truly appreciative of your efforts - and we're counting on your continued support in the future.

!!! THANK YOU !!!

About This Publication

The **TRANSEARCH** quarterly publication is prepared by the Research and Development Branch of Alberta Transportation and Utilities. The publication is dedicated to the effective transfer of transportation and utilities related research information and state-of-the-art technologies throughout the department.

In short news and feature articles, **TRANSEARCH** reports on the most interesting research and technologically significant events concerning the department.

In the interest of providing a vehicle for the effective transfer of technology throughout the department, Research and Development encourages department staff to provide proposals containing unique ideas, innovations or opportunities for research and evaluation which may provide solutions to the various technical needs of the department.

This publication is distributed throughout the department of Alberta Transportation and Utilities. Back issues are catalogued and retained in the department library. Copies of **TRANSEARCH** are also distributed to other Canadian D.O.T.s as well as Alberta Cities.

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The "New and Improved" Guardrail

by Richard Chow (Traffic Engineering Branch)

CANADIANA

DEC 21 1990

The ideal highway has roadsides and median areas which are flat and unobstructed by natural or man-made hazards. Unfortunately, in many instances, geography and economics do not allow these highway conditions. Therefore, guardrail barriers must be installed where warranted as a mitigative measure to reduce the probability of a vehicle striking the hazard.

Presently, the department uses the W-beam weak-post longitudinal guardrail system for the protection of errant vehicles from roadside hazards. This barrier system consists of treated wood posts and W-beam steel rails at 3.8 m post spacing. The top of the rail is mounted at 700 mm. The primary function of the posts in this system is to hold the barrier rail at the proper height when impacted by a vehicle. The W-beam guardrail basically acts as a tension ribbon and redirects the impacting vehicle when the rail is fully deflected. For this reason, installation at a given location is usually based on the ability to match the guardrail system's deflection properties (maximum 2.5 m) with the space behind the guardrail to safeguard a vehicle from hitting the hazard during a collision with the rail.

Due to changes in the size and weight of vehicles using our highway system, questions have been raised within the department as to the adequacy of the existing W-beam weak-post guardrail standards and the appropriate use of the turned-down terminal for end treatment.

IMPROVED SIDE SLOPE AND FLARED GUARDRAIL

About a year ago, Traffic Engineering Branch was requested to review the department's existing guardrail standards and to recommend improvements where necessary. After extensive literature research on guardrail protection and a survey of practices by other provinces and state agencies, we recommended a number of modifications to the present guardrail standards. These are:

1) flaring of the guardrail,
2) blocking out the rails and reducing the post spacing, and
3) improving the guardrail end treatment.

Last summer, with the cooperation of Region 3 and Operations Branch, these improvements were implemented at some 12 guardrail sites on Highway 2 in the Red Deer District. The purpose of these installations was to develop accurate cost figures, to fine tune the construction procedure, and to develop techniques that would incorporate guardrail location design with appropriate earthworks in the highway design process.

Flaring

A guardrail is flared when it is not parallel to the edge of the travelled way. The purpose of introducing a flare for a longitudinal guardrail is threefold:

1) To locate the guardrail and its terminal as far from the travelled way as is feasible and simultaneously reduce the length of guardrail required.
2) To redirect an errant vehicle without serious injuries to its occupants.
3) To minimize a driver's reaction to a hazard near the travelled way by gradually introducing a parallel guardrail installation. Perhaps, the most important reason of all for flaring is to prevent vehicles from hitting the end of the guardrail. Based on literature review and survey of practices, the most common flare rate used is 15:1 for roadway design speed of 110 km/h. This also corresponds to the recommendation

BLOCKED-OUT W-BEAM

of the Transportation Association of Canada (TAC).

Earthwork

An important feature of guardrail flaring is the area of the side slope between the edge of the shoulder and the face of the guardrail in the flare section. This area of the side slope must be kept as flat as possible to reduce the possibility of a vehicle vaulting over the rail. A slope of 10:1 or flatter is preferred. Therefore, it would be desirable to incorporate the side slope flattening in the initial design and highway construction stages to avoid extra work and expense when the guardrail is installed.

Design

Internationally the trend has been to move from the weak-post system to the strong-post system by reducing the present 3.8 m spacing by 50% to 1.9 m. In a strong-post system, the posts aid the rail in resisting vehicular penetration. On impact, the posts tilt slightly and push backwards in the ground and provide energy absorption without structural failure. For strong post system to function properly the rail is required to be blocked-out 15 to 20 cm from the posts. The Federal Highway Administration (FHWA) in the U.S. has conducted extensive studies on the blocked-out W-beam guardrail and shown that blocked-out guardrail systems have the advantage of maintaining the rail height during the initial stage of collision when there is the tendency for the rail to tip over. The reason for this is to ensure the integrity of the rail's function to absorb energy and to redirect the vehicle. A secondary, but very important, benefit of blocking out the rail is that it eliminates the possibility for the vehicle wheel to lodge under the rail resulting in an uncontrollable crash. A strong-post system also allows the placement of the rail closer to the hazard with less risk that a vehicle will penetrate far enough to strike the object. Strong-post systems are being adopted by most provinces and states as their standard guardrail protection.

Experience to date indicates that the time required to install the strong-post system is approximately two times that of the weak-post system. Initial calculation of the total labour and material cost to install a strong-post system is $50.00 per metre versus $27.00 per metre for a weak-post system as used in the past.

End Treatment

Guardrails which are used to protect roadside hazards can themselves become a hazard for vehicle leaving the road. A critical portion of the rail is the end exposed to the travelling public. It is essential to design the end to provide a crashworthy terminal which does not spear, vault, or roll a vehicle during head-on impacts while at the same time maintaining vehicle deceleration within recommended limits. Treating the

continued on page 10...

SENTRE SYSTEM ELIMINATES INHERENT GUARDRAIL END HAZARDS

C-SHRP Update

by Jan Konarzewski

Edited reprint of presentation given at the TAC Conference in St. John's, Newfoundland in September, 1990

Just to recap, C-SHRP is a $5.6 M program which is jointly funded by the provincial and territorial Departments of Transportation and Transport Canada. It is composed of the four sub programs with percentage financing as shown on page 6.

We are currently, exactly at the mid point of the program and are scheduling a review for later this year. This review will focus on work done to date and the directions planned to completion of the program.

The monitoring of SHRP has been mainly conducted on a continuous basis through the C-SHRP staff i.e., Greg Williams and Twiab Khan, and through visiting researchers in Washington. This is an ongoing process.

Technology Transfer has been rather slow, by the very nature of the beast. Test results have to be available before they can be transferred. There are now some products emerging from the SHRP and C-SHRP programs, so the C-SHRP Technical Steering Committee has been wrestling with a plan of action for this area. SHRP has identified five products which they hope to implement in a "fast track" manner. The committee is looking at those same five products and developing a transfer mechanism in C-SHRP which hopefully will evolve as a model for the transfer of all future products from both the SHRP and C-SHRP programs and will be self-sustaining even after C-SHRP is officially terminated.

The **Integral Program** with SHRP continues to be a very active area. Guy Dore (from the Ministere des Transports du Quebec) completed, in August, his one year stay in Washington as the third C-SHRP visiting researcher to SHRP. He has just been replaced by Ataur Bachus from the Ministry of Transportation of Ontario. We have also continued representation on the four SHRP Advisory Committees, the Executive Committee and on various Expert Task Groups.

The **Long Term Pavement Performance** has of course not only been very active, but has produced a very significant commitment to the project both in terms of sites, and agency resources to monitor their performance.

In the **General Pavement Sections (GPS)** there are a total of 44 sites across Canada with provincial representation as shown. These sites include asphalt concrete over granular base (20 sites); asphalt concrete over stabilized base (8 sites); jointed plain concrete (5 sites); asphalt concrete overlay of asphalt concrete (9 sites); asphalt concrete overlay of jointed portland cement concrete (1 site) and unbounded overlay of jointed portland cement concrete of continuously reinforced concrete (1 site).

Much activity has focused around each of these test sections during the last year. Marking and material sampling has been done at each site, through drilling, coring and test pit excavation. The Pasco unit has passed through each section recording pavement surface distress, as well as the Falling Weight Deflectometer and Benkleman Beam to determine structural capacity. Traffic information plans are being developed to install instrumentation at each site capable of recording counts, classifications and weight information.

Of the ten **Specific Pavement Section (SPS)** experiments, Canada is participating in three. SPS sites are a major undertaking, since these are not existing pavements, but ones that have to be specially built for the experiment.

During the year seven Asphalt Pavement Maintenance Treatment Effectiveness (SPS 3) test sites have been built; 2 in Saskatchewan; 2 in Manitoba; 1 in Ontario; and 2 in Quebec. The strategies being evaluated are chip seal, slurry seal, thin overlay and crack filling.

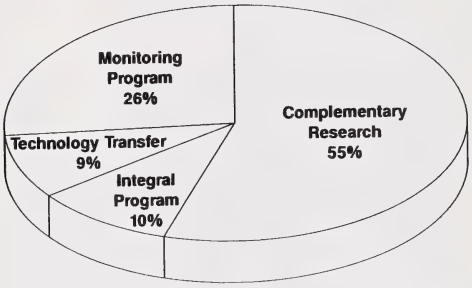
In addition Quebec has constructed an SPS 4 site which looks at the effectiveness of crack and joint sealing in Portland Cement Concrete.

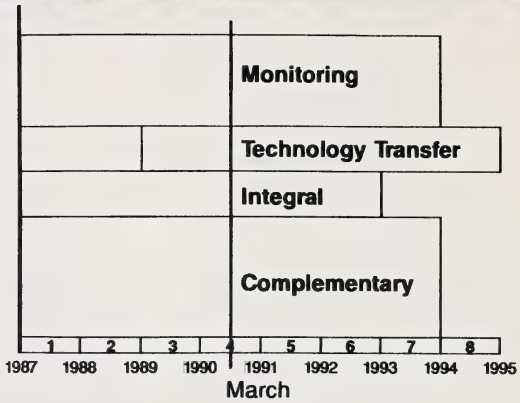
SPS 5 is the Rehabilitation of Asphaltic Concrete Pavements experiment and to date Alberta and Manitoba have constructed these sites. This experiment is a study of pavement performance subjected to rehabilitation with thick and thin asphalt concrete overlays using recycled and virgin materials with minimum and intensive surface preparation.

The **Complementary Program** has also been very active over the last year. All but one project is underway and the last one should be awarded before the end of the year. The Pavement Response Studies contract was awarded to Alberta Research Council in 1988. As a result of limited work carried out since that time, a refocussing of the project has been conducted. In particular, because of existing instrumentation limitations, investigation of tire pressure upon pavement response will not be undertaken within C-SHRP. Because of lack of a truly national focus, investigation of load

C-SHRP

Canadian Strategic Highway Research Program

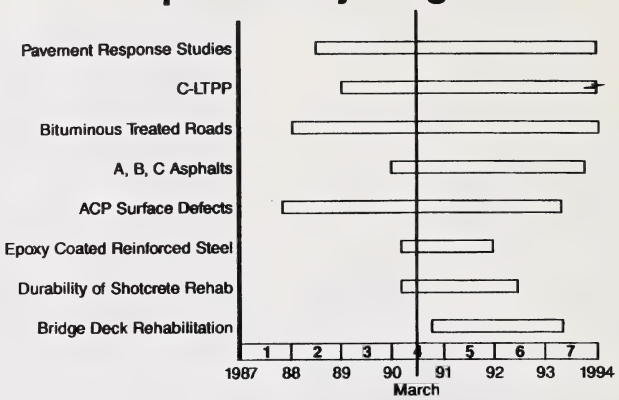




Integral Program

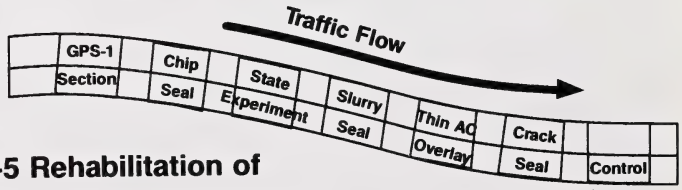
- Visiting Researcher
- Committee Representation
- Expert Task Groups
- Long Term Pavement Performance
  - GPS
  - SPS

Complementary Program

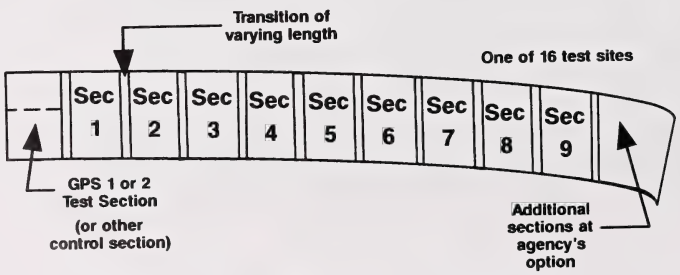


Canadian GPS Sites

SPS-3 Pavement Maintenance Treatment Effectiveness



SPS-5 Rehabilitation of Asphaltic Concrete Pavements



COMPLEMENTARY PROGRAM

Bituminous Treated Roads

Objectives:

- To assess the relative performance of different BTR strategies
- To develop a technically rational thickness design for granular base course in BTR
- To quanitify the effect of heavy loads on BTR including the rationalization of spring load bans
- To develop warrants for the selection of optimum seal strategy (i.e. graded vs uniform aggregate; single vs double seal, etc.)

Performance Correlation for Quality Paving Asphalts

Objectives:

- To document the range of products and practices for paving asphalts in Canada
- To enhance the understanding of asphalt cement properties which influence low temperature performance and rutting
- To correlate significant asphalt cement properties to field performance
- To provide field correlated support to the Canadian General Standards Board specifications for paving asphalts

Corrective Measures for Surface Defects in Flexible Pavements

Objectives:

- To quantify the effectiveness of existing maintenance techniques from current literature and from undocumented empirical field procedures
- To identify existing or alternative maintenance practices and materials which warrant further testing and analysis
- To evaluate alternative maintenance procedures and materials
- To develop a cost benefit framework to optimise maintenance practices

Effectiveness of Epoxy Coated Reinforcing Steel

Objectives:

- To determine whether fusion bonded epoxy coatings are effective in providing long term corrosion protection for reinforcement
- To identify the factors which have the greatest influence on the performance of epoxy coated reinforcement
- To prepare model specifications for epoxy coated reinforcement

Durability of Shotcrete Rehabilitation Treatments

Objectives:

- To identify those construction and application factors which contribute to the quality of the rehabilitation repairs and to quantify their effect on performance
- To determine those material factors which have the most significant effect on service life and to quantify their effect
- To develop service life predictions for shotcrete repairs using various combinations of material and application methods

Concrete Bridge Deck Rehabilitation Methods

Objectives:

- To assess performance of concrete overlays and waterproofing membranes as used previously by road authorities in Canada for bridge deck rehabilitation and protection
- To quantify the service life of the identified treatment types
- To prepare a recommended practice for concrete overlays and waterproofing membranes which have been shown to perform satisfactorily

equivalency factors will not be pursued within C-SHRP, although individual provinces are encouraged to provide vehicles of regional interest for testing in conjunction with other C-SHRP activities.

The study of seasonal variation of pavement response has been singled out as the focus, through integration of existing vehicle weights and dimensions sites with current C-LTPP sites. As a result, two C-LTPP sites one each in Alberta and Ontario are being suitably instrumented for measuring pavement strains and on line traffic monitoring, while a third site is being negotiated with Quebec. In addition, the existing fully instrumented vehicle weights and dimension sites in Nova Scotia and New Brunswick have been included as part of the experiment.

C-LTPP progress will be dealt with in the next issue of TRANSEARCH.

The **Bituminous Treated Roads Analysis** project, whose objectives are shown on page 7, was awarded to the Centre de Recherche et de Controle Applique a La Construction in May of this year. The project has reached its second phase where field testing will be required. A workshop is planned for this fall with the contractor, the project committee, and the host provinces, to fine tune the field experiment in light of committee review and capabilities of provinces to support test sites. Site solicitation will be conducted this fall with site establishment in 1991.

The objectives of the **Performance Correlation of Quality Paving Asphalt** are as shown on page 7. This project was awarded early in the year to EBA Engineering. The contractor has completed the first phase of the project and has proposed two major test sites to be constructed in Canada in 1991.

The first site, typical of the prairies and its climate, would have glacial aggregate and traffic of between 500,000 and 5,000,000 design ESALS. The second site, typical of Ontario and Quebec, and their climate, would have quarried aggregate and traffic in excess of 5,000,000 design ESALS.

Each test section would contain A, B, and C asphalts with the asphalt concrete layer varying between 100 and 150 mm. The test section would be duplicated at each site and be continuous. At the present time Alberta is favourable to constructing a test site and negotiations are underway with Quebec and Ontario for a second site. A firm commitment later in the fall is required to proceed with construction in 1991.

The **Corrective Measures for Surface Defects in Flexible Pavements** project has continued throughout the year with objectives as shown on page 7. The major part of decision trees (matrices or assignment tables) that relate pavement deficiencies to applicable maintenance techniques has been completed. The contractor Pavement Management Systems has proposed a set of field trials which exceed the capabilities of the provinces in light of other C-SHRP activities. A workshop is planned for late this fall together with the contractor, the project committee and participating provinces to complete the decision trees and work out a set of field trials for 1991 which will satisfy the objectives of the project yet stay within the support capabilities of the participating agencies.

The **Effectiveness of Epoxy Coated Reinforcing Steel** project was awarded to Kenneth Clear Inc. of Virginia, U.S.A., in May of this year. The objectives of the project are as shown on page 7. A lot of background work has been conducted by the contractor as dictated in the project. A primary ongoing effort of K.C. Clear and Bell Laboratories for the Concrete Reinforcing Steel Institute, which has significant interaction with our project, is the processing of data from tests on specimens that underwent accelerated laboratory exposure in order to relate characteristics of the epoxy film to actual corrosion performance. Additionally, the contractor is working with selected States to identify structures which will be evaluated in the field and their cores will be retrieved for detailed laboratory analysis. These structures are predominantly in the north-eastern de-icing salt region of the United States. Ontario Ministry of Transportation has also provided valuable information from the coring of barrier walls. The contractor has produced a Phase I report identifying the characteristics of epoxy film which most relate to corrosion performance; proposing tests on both concrete and rebar from various classes of structures and from coating plants; identified possible cooperating agencies and structures available in Canada, and developed a detailed work plan for field investigation in Phase II.

Durability of Shotcrete Rehabilitation Treatments with objectives as shown on page 7, was awarded to Hardy BBT in June of this year. The contractor has now conducted a literature review of current practices and has completed preliminary field surveys in British Columbia, Alberta, Ontario, Quebec, and the Maritimes. This will be followed up next year with extensive examination on selected sites.

The objective of the **Concrete Bridge Deck Rehabilitation Methods** project are as shown on page 7. Solicitation of interest in the research project closed this September 14th. An RFP has just been put out and contract award is expected in early December.

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INNOVATIVE IDEAS

Do you have an innovative product or idea that may be beneficial to Alberta Transportation and Utilities but don't have time to give it the exposure it deserves.

Technology Transfer personnel would welcome the opportunity to go to your Branch or District to find out more about your innovation and then write an article about it for our next issue of Transearch. Contact Ray Filiplak at 422-2750.

"Lighting Up" Our Highways

by Allan Lo

Driving at night is often associated with an increase in risks of becoming involved in collisions because the driving task is made that much more difficult with the loss of daytime visual cues. To compensate for the loss, guidance is normally provided by line markings on the pavement, retro-reflective signs, delineators, and street lighting along the highways. In an effort to supplement these standard devices, two market products were recently tested by the department for additional nighttime delineation.

BRIDGE REFLECTOR

On long narrow bridges where shoulder width is little to none, a driver may feel uneasy driving so close to the sides of the bridge in darkness. Illumination can be a solution, but it is an extremely costly one, especially when only a small number of drivers will actually benefit from it. A research project began in 1988 to investigate the use of commercially available reflectors as a means of "lighting up" the bridge structure. After some initial testing with several delineator products, the Stimsonite 967 (see photo) became the preferred choice, and the Dunvegan suspension bridge on Highway 2, north of Grande Prairie was selected to be the test site.

The Peace River regional bridge staff were the main participants and evaluators in the project, and installed 100 of the Stimsonite markers on the Dunvegan bridge in May of 1989. The conclusion reached after one winter season was that the reflectors were easy to install, and they worked well in providing a guided path of lit spots (analogous to a lit runway) along the bridge, for drivers. It was also a cost-effective approach considering the project cost only $800. There was one detraction in that the markers broke off easily from rocks and other debris thrown from normal traffic as well as snowplows. In the final analysis (ABTR/RD/TM-90/04), the reflector delineation method was recommended for similar application

ILLUM-O-RAIL

at other long and narrow bridges.

In the other delineation project, the department was approached to test out a product called Illum-O-Rail, claimed to enhance the daytime and nighttime delineation of flexbeam guardrails. Moulded in the "W" form of the flexbeam shape (see photo), the plastic can be simply attached onto existing rails without any special tools. The white-coloured plastic provides contrast against the steel to make the guardrail stand out in daylight hours; while the pavement marking tape in the middle is intended to "light up" when a vehicle's headlight shines on it at night.

Over 250 m of the material was purchased and installed by Operations Branch at various highway sites surrounding the City of Edmonton in March of 1990. It was obvious that the white colour would make the guardrail more conspicuous in daytime, but this was not the main concern; it was at night when the added delineation of the guardrail hazard would be more useful. As it turned out, a nighttime inspection showed that the tape only became visible when the vehicle was driving next to it. This was clearly not acceptable and made more so by comparison with the reflective strips that were normally installed on the guardrail wood posts for delineation - those strips were brightly lit from several hundred meters away. The pavement tape used on the Illum-O-Rail, as the name implies, is designed for the road surface on which the headlight beams are normally focused; it appears that this particular application of the tape does not work. Needless to say, the final report (ABTR/RD/TM-90/05) did not recommend any further purchase of the product. You can't win 'em all!

§

***GUARDRAIL** continued from page 4*

end also provides the necessary anchorage to develop the tensile strength of the guardrail throughout its length.

For a considerable time, the department's standard has been to turn down the guardrail ends from its full height to ground level over a distance of 8 metres. The turned-down end treatment is intended to collapse under the weight of the vehicle, allowing the vehicle to pass over the rail and to stop gradually.

There are several alternatives to the turned-down guardrail end treatment which provide a greater degree of safety and are becoming more popular. One involves burying or anchoring the guardrail end section into the back slope or into an earth mound. At the recommended 15:1 flare rate, this type of buried end treatment eliminates the exposed end and provides the necessary anchorage. This design has not been tested yet on our highways but is being considered for use on new highway construction projects where it can be incorporated into the earthwork.

A number of commercial guardrail terminals are available for use where the buried system cannot be used. As part of the trial installations in the Red Deer District four commercial guardrail end treatments (Breakaway Cable Terminal, Sentre System, Crash-Cushion Attenuating Terminal, and Brakemaster System) were installed at various sites along Highway 2. Basically, all of these end treatments work on the principle of energy absorption on impact and redirection of the vehicle depending on the angle of hit. These fixtures are costly (approximately $12,000 each to install) but they could be justified for use on high speed and high volume facilities or in special situations where the area of the terminal section is limited.

In recent weeks, approval has been given to implement these new guardrail standards on Highway 2 between Edmonton and Calgary in conjunction with any upgrading of this route. With the expected benefits these standards will probably be implemented for the entire primary highway system.

§

TRANSPORTATION SOFTWARE

McTRANS (Center for Microcomputers in Transportation) is a software distributor and user support center established by the FHWA (Federal Highway Administration) and is based at the University of Florida.

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If you would like to receive a copy of the latest McTRANS catalog contact: Robert Powers at 422-2750.

BACK ISSUES

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Tornadoes In Iowa!

by Allan Lo

What do tornadoes in Iowa have to do with transportation research, you may ask? Well, nothing....aside from the fact that yours truly, along with Sue Khalil from Materials Engineering, were in Ames, Iowa to attend a seminar on pavement distress measuring equipment, and on the first muggy night there we kept hearing broadcasts blaring warnings of tornadoes in nearby counties. As the weather changed from minute to minute, we Albertans began to feel right at home!

All that excitement aside, I, for my part, went to Ames to examine in detail, a display of state-of-the-art equipment now available in the marketplace to measure, record and analyze various pavement distress parameters, keeping in mind the department's Mobile Highway Inventory Videolog System and the ARAN vehicle (Automated Road Analyzer) for measuring pavement roughness, rutting and cracking (Transearch Vol.1, No.3). There were about a dozen vendors showing off their latest products and know-how. Vendors were primarily American companies, though one Canadian company (HPI, the ARAN people) and an Australian company were also in attendance.

Panel trucks, conversion vans, mini vans, vehicles of all sizes, with testing and data collection equipment of all varieties were paraded around Ames, giving seminar attendees a first-hand look at the equipment's operation. For visual recording of roadways and pavement distress, most vendors used the video tape format we currently employ both in our videolog van and the ARAN; one supplier used 35mm film. To measure rutting, both ultrasonics and laser sensors were demonstrated. However, what was of most interest to me was the post-processing of video images by means of "distress pattern recognition programs". Only four vendors have developed software to attempt the job of identifying different distress types automatically. I say attempt because these packages are still far from perfected, as only two or three types of distresses can be recognized with any degree of confidence. We have, in fact, been working with one of these companies to post-process some of our videotaped images of the pavement surface (as collected by ARAN) and a second company may also be interested in trying to process our tapes, to demonstrate the potential of their distress pattern recognition program.

The state highway agencies of Connecticut and Iowa were also at the show displaying their production technologies for videologging. The images from Connecticut's photographic film (35mm) and Iowa's laser optical disks were quite impressive and were successfully combined with a user-friendly computer database. This information could prove quite useful once our own videolog vehicle needs refurbishing and upgrading.

Last but not least, two vendors demonstrated a radar and a laser system respectively, for detecting voids, deterioration and delaminations in concrete structures (such as a bridge deck) beneath an asphalt pavement. Although R & D looked at this some time ago (see Report No. ABTR/RD/RR 87-03), this latest system uses new techniques and could well be worth further investigation. Now if only it could detect tornadoes as well....!

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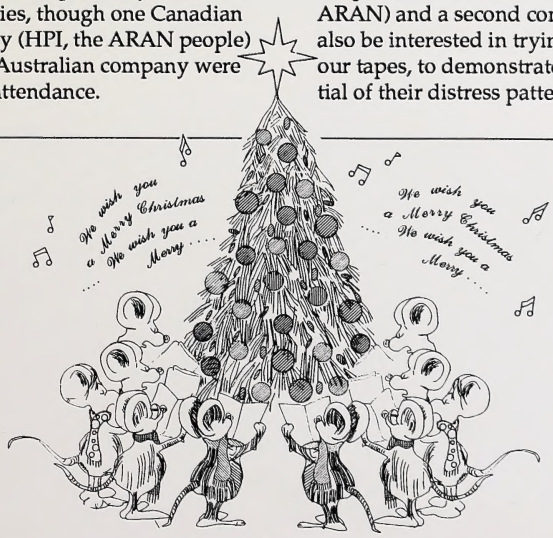
In, October, Bridge Engineering Branch and the city transportation departments of Edmonton and Calgary joined forces in bringing the consultant to Alberta to evaluate twenty three bridge structures.



On behalf of the
Research and Development Branch
I would like to wish all
TRANSEARCH readers
A Merry Merry Christmas
& A Great New Year !!!!!

Director, Research & Development

SHRP PUBLICATIONS

Report No.: SHRP-A/IR-89-004
Title: **Summary Report On Aging Of Asphalt-Aggregate Systems,** November 1989
Author: SHRP / C.A. Bell, Oregon State University

Report No.: SHRP-A/IR-89-003
Title: **Summary Report On Water Sensitivity (Asphalts),** November 1989
Author: SHRP / R.L. Terrel, J.W. Shute, Oregon State University

Report No.: SHRP-A/IR-90-001
Title: **Summary Report On Low Temperature Thermal Fatigue Cracking,** June 1989
Author: SHRP / T.S. Vinson, Oregon State University / V.C. Janoo, US Army Cold Regions Research & Engineering Lab / R.C.G. Haas, University of Waterloo

Report No.: SHRP-A/IR-90-015
Title: **Asphalt Properties And Relationship To Pavement Performance: Literature Review,** May 1990
Author: SHRP / F.N. Finn, ARE Inc. Engineering Consultants

Report No.: SHRP-A/IR-90-014
Title: **A Literature Review Of The Absorption Of Asphalt Functionalities On Aggrgate Surfaces**
Author: SHRP / Y.W. Jeon, C.W. Curtis, Auburn University

Report No.: SHRP-A/IR-90-011
Title: **Summary Report On Fatigue Response Of Asphalt Mixtures,** February 1990
Author: SHRP / S.C.S. Rao Tangella et al, University of California, Berkeley

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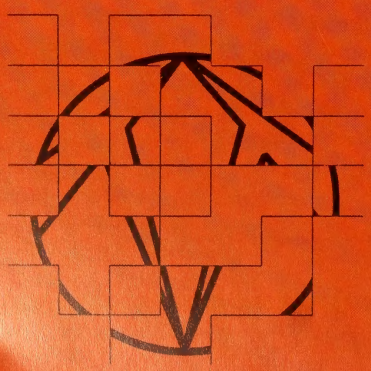
R & D PUBLICATIONS

ABTR/RD/TB-90/01
Author: J. Lowe
Title: **"Differential Mode Recorders"**
Brief: This report describes the application of differential mode recorders for measuring idling times versus operating times for vehicle engines.

ABTR/RD/TM-90/04
Author: A. Lo
Title: **"Bridge Rail Delineation"**
Brief: This paper summarized a one-year evaluation of the Stimsonite 967 marker and 3 M Stamark line tape as enhanced nighttime delineation for a long narrow bridge.

ABTR/RD/TM-90/05
Author: A. Lo
Title: **"Illum-O-Rail Guardrail Delineation"**
Brief: The Illum-O-Rail product was evaluated for increased delineation of flexbeam guardrails during nighttime driving conditions.